FAA-E-2803
February 12, 1987

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

POTENTIAL ISOLATION TRANSFORMERS
FOR
AIRPORT LIGHTING SYSTEMS

1. SCOPE

1.1 Scope.- This specification sets forth the requirements for potential isolation transformers for use in airport lighting systems.

1.2 Classification.- Two types of transformers are covered by this specification:

Type I	200-watt transformer
Type II	300-watt transformer

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA specifications and standards, of the issues specified in the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA specifications.-

FAA-G-2100	Electronic Equipment, General Requirements
AC 150/5345-26	Specification for L-823 Plug and Receptacle, Cable Connectors

AC 150/5345-7	Specification for L-824 Underground Electrical Cable for Airport Lighting Circuits

2.1.2 FAA standard.-

FAA-STD-013	Quality Control Program Requirements

2.2 Military and Federal publications.- The following Military and Federal publications, of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military specifications.-

MIL-P-116	Preservation, Methods of
MIL-C-4921	Cable, Power, Electrical, Airport Lighting, General Requirements for
MIL-I-7798	Insulation Tape, Electrical, Pressure-Sensitive Adhesive, Plastic
MIL-E-17555	Electronic and Electrical Equipment, Accessories and Repair Parts, Packaging and Packing of

2.2.2 Military standard.-

MIL-STD-810	Environmental Test Methods

2.3 Other publications.- The following publications, of the issues in effect on the date of the invitation-for-bids or request-for-proposals, form a part of this specification and are applicable to the extent specified herein.

2.3.1 American Society for Testing Materials (ASTM) standards.-

B-33	Tinned Soft or Annealed Copper Wire for Electrical Purposes, Specification for
B-189	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes, Specification for
D-753	General Purpose Neoprene Sheath for Wire and Cable
D-1149	Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens), Test for
D-2240	Indentation Hardness of Rubber and Plastic by Means of a Durometer

2.3.2 Insulated Cable Engineers Association (ICEA) standard.-

S-19-81 General Specifications for Wire and Cable with Rubber, Rubber-Like and Thermoplastic Insulations

(Copies of this specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation for bids or request for proposals. The requests should fully identify material desired, ie., standard, drawing, specification, amendment number, and date. Requests should cite the invitation for bids, request for proposals, or contract involved or other use to be made of the requested material.)

(Requests for copies of military specifications and standards should be addressed to Naval Publications and Forms Center, Attention: NPEC-105, Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.)

(Information on obtaining ASTM standards may be obtained from the American Standards Institute, 70 East 4th Street, New York 10017.)

(Copies of ICEA publications may be obtained from the National Electrical Manufacturers Association (NEMA), 2101 L Street, N.W., Washington, D.C. 20037.)

3. REQUIREMENTS

3.1 General.- The transformers furnished under this specification will be used in parallel-connected constant voltage lighting systems. The transformers shall provide isolation between the primary potential circuit and the secondary lamp circuit. The transformers shall be suitable for direct earth burial, exhibit electrical characteristics as specified herein, and shall be equipped with quick-disconnect connectors.

3.2 Electrical characteristics.- The electrical characteristics of the transformers shall be as shown in table I and as described below.

3.2.1 Temperature rise.- The temperature rise of the transformer shall not exceed 131°F (55°C) when the transformer is operated in air with rated current flowing in the primary and with rated load on the secondary.

3.2.2 Insulation/resistance.- The transformer, leads and connectors shall withstand the test conditions specified in 4.2.3.

3.3 Physical characteristics.- The transformer shall be designed and constructed so that no parts will work loose in service. The transformer shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service. The exact shape and design of the transformer shall be optional, provided all requirements specified herein are met and the maximum dimensions specified hereinafter are not exceeded.

Table I. Transformer Electrical Characteristics

Parameter	Type I	Type II
Transformer Rating	200 Watts	300 Watts
Power Factor	0.98 or Better	0.98 or Better
Efficiency	95% or Better	95% or Better
Frequency	60 Hertz	60 Hertz
Primary Voltage	240 Volts AC	240 Volts AC
Secondary Full Load Voltage	30.00 to 30.60 Volts AC	45.04 to 45.96 Volts AC
Secondary Full Load Current	6.6 Amperes	6.6 Amperes
Secondary Load	4.6 Ohms	6.89 Ohms
Maximum Open Circuit Voltage	43 Volts Peak	67 Volts Peak
Voltage Rating	Primary - 600 Volts	Primary - 600 Volts
	Secondary - 600 Volts	Secondary - 600 Volts

Note: Measurements are to be made using a 240-volt, sinusoidal, 60 Hertz source having no more than 5 percent distortion and with the transformer constituting no more than 10 percent of source capability.

3.3.1 Coils.- The transformer shall consist of primary and secondary coils wound around a core and enclosed in a waterproof case. The transformer shall have molded rubber connectors on the primary and secondary leads. The windings shall be insulated from each other and the core. Windings of the core assembly shall be tightly wound and secured prior to molding. The transformer shall be designed to operate continuously under full load, with rated voltage and frequency in the primary. The transformer shall not emit any sound when operating at full or no load.

3.3.2 Case.- The transformer shall be enclosed in a permanently sealed case so as to produce a completely watertight assembly. No portion of the case shall be less than 1/4 inch (0.635 cm) thick, and the case shall be free of cracks, blisters, holes, and voids. Sharp corners and edges of the core and coil assembly shall be eliminated or adequate provisions shall be made so that they will not cut the case in the event the transformer is dropped or handled roughly. The case shall be constructed so that moisture accidentally getting into the leads or connectors could not be conducted through the leads into the windings of the transformer. The case shall be composed of material formed directly on the core and coil assembly or preformed and compound-filled. The

material shall meet the physical requirements of ASTM D-753. The minimum strength requirements shall consist of the following:

(a) Tensile strength: 1200 psi (84 kg/cm^2)

(b) Tensile strength after a 96-hour oxygen bomb test: 1000 psi (70 kg/cm^2)

(c) Tensile strength after 168-hour oven tests at 157-159°F (69-71°C): 1000 psi (70 kg/cm^2)

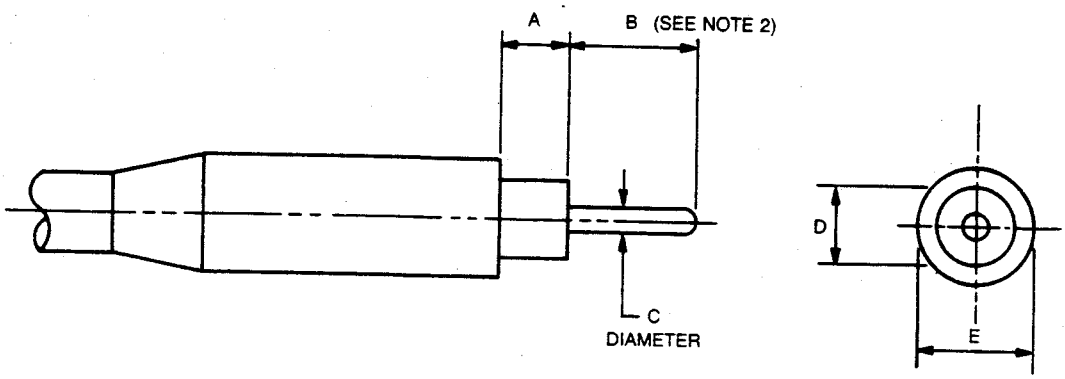
(d) Durometer hardness shall be 65±10 as measured in accordance with ASTM D-2240.

3.3.2.1 Air pockets.- Internal air pockets shall be eliminated. The assembly shall be sufficiently sturdy to withstand rough handling. There shall be no improper molding or bonds as evidenced by bubbles, blisters, or cracks. The case of the completed transformer shall be firm to the touch at all points and show no indention (except for compression of case compound) when subjected to pressure which can be exerted directly by the hands.

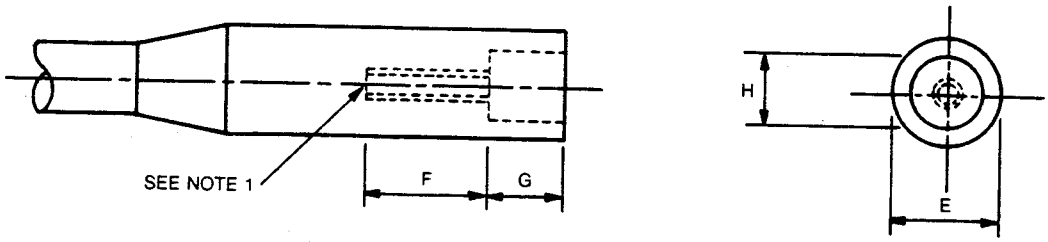
3.3.2.2 Size.- The case shall be designed so that the transformer may be installed upright or lying on any side. Rectangular-shaped designs shall not exceed 6-3/4 by 6-3/4 by 8 inches (17 by 17 by 20.3 cm) in overall dimensions excluding leads. Cylindrical designs shall not exceed 7-3/8 inches (18.73 cm) in diameter by 8 inches (20.3 cm) in height. Attachment of the transformer leads shall allow the case to be installed in a cylindrical container 11 inches (27.9 cm) in diameter.

3.3.3 Transformer leads.- The transformer shall be provided with a two-conductor secondary lead and two single-conductor primary leads. Lead connections shall be of the solderless type. Solderless connectors used in joining leads to the transformer windings shall be of a type designed for that application and properly installed. Care shall be exercised during molding to insure that proper clearance exists between the lead connections after the molding operation has been completed. All three leads shall emerge from one end of the transformer. Spacing and arrangement are optional, provided all other requirements are complied with. The leads shall be securely fastened to the transformers in such a manner that a 5-minute, 50-pound (22.67 kg) pull test, or the bending/twisting of leads normally occurring during testing and installation, will not loosen the electrical connections or affect the water seal. The case shall form a permanent watertight junction with the leads. At the junction, the case compound shall provide a reinforcing area for the leads. At the case surface, the reinforcing shall be at least 25 percent greater than the outside diameter of the connecting leads. The reinforcing may be of a cone shape around individual leads or a continuous ridge enclosing all three leads, and shall form an integral bond with the entire cable sheath within this reinforcing cone or ridge.

3.3.3.1 Primary leads.- Each primary lead (H1 & H2) shall be equipped with a plug-type connector and receptacle conforming to figure 1 and table II. A No. 8 American Wire Gage (AWG), 19-strand, single-conductor cable insulated for not less than 600 volts shall be used. The insulation shall be ethylene-propylene rubber (EPR), ozone-resistant, UL approved for direct-earth-burial (DEB), and compatible with the case molding compound. Each primary lead shall



(a) PRIMARY LEAD PLUG, SINGLE-CONDUCTOR 25-AMPERE, 600 VOLTS TO GROUND.



(b) PRIMARY LEAD RECEPTACLE, SINGLE-CONDUCTOR, 25-AMPERE, 600 VOLTS TO GROUND.

NOTES:

1. METAL SOCKET SHALL BE RECESSED NOT MORE THAN 1/8 INCH (0.318 CM) BELOW INSIDE FACE OF RECEPTACLE, AND BEFORE SPLITTING SHALL HAVE AN I.D. OF 0.188 ± 0.001 INCH (0.478 ± 0.003 CM)

2. SEE TABLE II FOR DIMENSIONS

Figure 1. Transformer Primary Plug and Receptacle

Table II. Transformer Plug and Receptacle Dimensions

Dimension	Inches	Centimeters	Reference
A	0.593 +0.015,-0.000	1.506 +0.038,-0.000	
B	1.062 ±0.015	2.697 ±0.038	
C	0.186 ±0.001	0.472±0.003	
D	0.604 +0.010,-0.000	1.534 +0.025,-0.000	
E	0.937 +0.000,-0.031	2.380 +0.000,-0.079	
F	1.080 Minimum	2.743 Minimum	
G	0.608 +0.000,-0.015	1.544 + 0.000,-0.038	
H	0.573 ±0.010	1.455 ± 0.025	
I	1.125 ±0.031	2.857 ±0.079	Receptacle
J	1.750 ±0.031	4.445 ±0.079	Receptacle
K	1.500 ±0.031	3.810 ±0.079	Receptacle
L	0.694 ±0.010	1.763 ±0.025	Receptacle
M	1.000 +0.000,-0.031	2.540 +0.000,-0.079	Plug, Receptacle
N	0.641 Minimum	1.628 Minimum	Depth of Socket Includes 0.125" (0.318 cm) Recess Below Inside Face of Receptacle
O	0.358 + 0.000, -0.015	0.909 +0.000,-0.038	Receptacle
P	0.157 ±0.001	0.399 ±0.003	Socket Diameter Before Splitting Connector For White Wire

Table II. Transformer Plug and Receptacle Dimensions - Continued

Dimension	Inches	Centimeters	Reference
Q	0.126 ±0.001	0.320 ±0.003	Socket Diameter Before Splitting Connector For Black Wire
R	0.435 ±0.010	1.105 ±0.025	Receptacle
S	1.750 ±0.031	4.445 ±0.079	Receptacle

be extended 24+3 inches (60+7.5 cm) beyond the housing, including the cable connector.

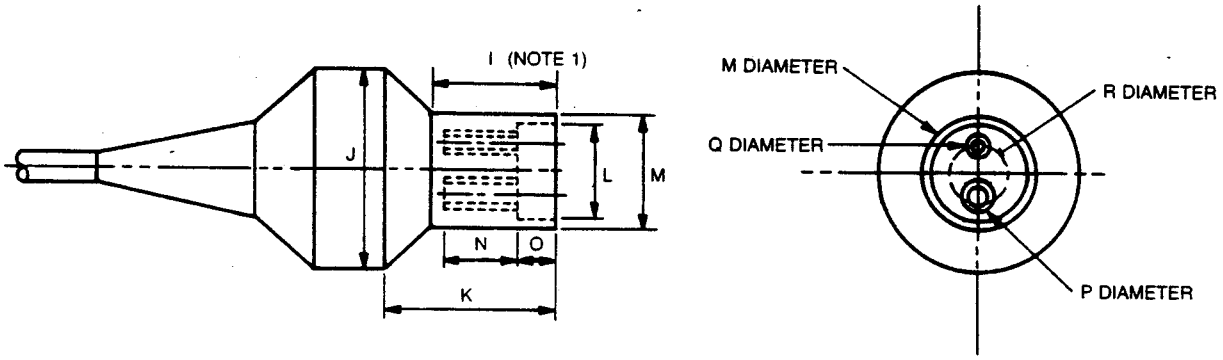
3.3.3.2 Secondary leads.- The secondary lead shall be equipped with a receptacle conforming to figure 2 and table II. The receptacle shall be so wired that the large contact will connect to the X1 lead of the transformer secondary and the smaller contact will connect to the X2 lead. A No. 14 or 12 AWG, stranded two-conductor, 600-volt, secondary cable shall be used. The cable insulation shall be elthylene-propylene rubber (EPR) ozone-resistant, UL approved for direct-earth-burial (DEB), and compatible with the case molding compound. The secondary lead cable shall extend 24±3 inches (60±7.5 cm) beyond the housing, including the cable connector.

3.3.3.3 Caps.- A watertight cap shall be placed on each connector for protection during shipment and installation. The cap shall consist of a plastic, rubber or rubber-like plug (or receptacle) designed to protect the mating surfaces of the connector from moisture and dirt. Insulation tape at least 7-mils (0.17-millimeter) thick and 3/4-inch (1.9-cm) wide, conforming to MIL-I-7798, shall be wrapped over the joining seam to hold the cap in place and to protect against dirt and moisture.

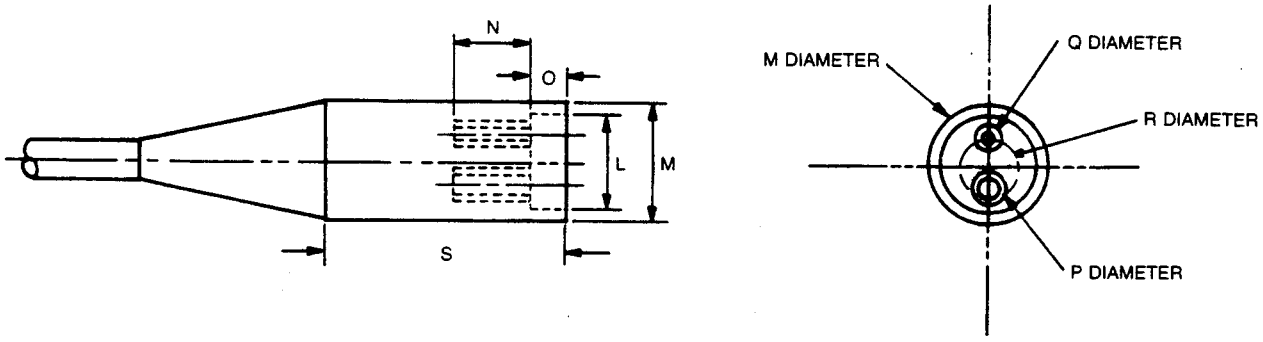
3.3.4 Cable connectors.-

3.3.4.1 Electrical connection.- The voltage drop across the contacts of a connected plug and receptacle shall not exceed 7.5 millivolts (mV) for the primary connectors or 6.0 mV for the secondary connectors.

3.3.4.2 Bonding strength.- The bond between the cable and the molded-on plug or receptacle shown on figure 1 shall withstand a pull of at least 75 percent of the test force required in determining the mechanical strength of a completed cord as set forth in ICEA Standard Publication S-19-81, Table 7.7-8, Strength of Completed Cord. Cord conductors not covered by this table and cable bonded to the molded-on plug or receptacle shown on figure 1 shall withstand a pull of at least 30,000 pounds-per-square-inch (psi) (207 megapascal (MPa)). This value is based on 75 percent of an average tensile



(a) SECONDARY LEADS RECEPTACLE, TWO-CONDUCTOR,
20-AMPERE, 600 VOLTS BETWEEN CONTACTS, 1500 VOLTS TO GROUND



(b) SECONDARY LEADS RECEPTACLE, TWO-CONDUCTOR
20-AMPERE, 600 VOLTS BETWEEN CONTACTS, 1500 VOLTS TO GROUND

NOTE:
1. SEE TABLE II FOR DIMENSIONS.

Figure 2. Transformer Secondary Receptacles

strength of 40,000 psi (276 MPa) for all wire sizes. The wires are in accordance with ASTM Specification B 33 and B 189.

3.3.4.3 Mechanical connection.- Each connected plug and receptacle shall withstand a static pull load of 10 pounds (44 newtons (N)) without showing evidence of separation.

3.3.4.4 Seal.- A watertight seal shall be provided between the mated plug and receptacle and between rubber and metal parts of the plug and receptacle.

3.3.4.5 Housing.- The connector housing shall be molded from natural and/or synthetic elastomeric materials serving both as insulation and sheath to fully enclose the pins and sockets of the connectors. The material shall be suitable for direct earth burial, submergence in water, and capable of withstanding limited chemical, oil, or gasoline attack. Housings for the connectors shall be fabricated from materials capable of bonding to cable sheaths or conductor insulation, during the vulcanizing process, to provide a watertight bond. Material compounds used in connector housings shall not contain more than 25 pounds (11 kilograms (kg)) of carbon black per 100 pounds (45 kg) of elastomer. Housings for the connectors shall withstand exposure to direct sunlight and to ozone.

3.3.4.6 Pins and sockets.- The pins and sockets shall be designed to conform to the dimensional and construction requirements as indicated on figures 1 and 2. The sockets shall be slotted and spring loaded to insure good electrical contact as required by paragraph 3.3.4.1. Pins and sockets provided shall have provisions for crimping to the cable conductor(s) at a job site. The metal of the pins and sockets for connectors shall not exhibit damage after crimping. Pins and sockets shall be made of materials that contain at least 98 percent copper. Sockets shall be fully annealed and supplied with a copper beryllium sleeve-type spring which assures adequate contact pressure and protects the socket slots from filling with insulating compound during assembly and subsequent use. The pins shall be made from material at least "half hard" with the crimping section fully annealed. The contact portion of the pin shall be left "stock hard." The hardness transition shall be limited to the locking section of the pin. The pin and socket shall be electroplated with tin or other suitable material to provide good electrical contact. Pins and sockets shall be held perpendicular to the face of the block. Suitable electrical conductors shall be mechanically and electrically connected to the pin(s) or socket(s), and then the housing shall be molded per 3.3.4.5. Do not mold a connector to an electrical conductor or cable having a higher voltage rating than the specification requirements for the connector. After molding, the space between dual pin connectors shall not be less than 1/8 inch (3 mm) when the pins are pinched together with a force of 6 pounds (27 newtons (N)) applied 1/2 inch (12.7 mm) out from the face of the plug. Also, the space between the ends of the pins shall not be greater than 9/16 inch (14.3 mm) when the pins are pulled apart with a force of 6 pounds applied 1/2 inch (12.7 mm) out from the face of the plug. The force is applied to the pins only. The plug is to be held only to keep it from turning.

3.3.4.7 Marking.- Each plug and receptacle shall be marked with the manufacturer's identification and L-823 designation.

3.3.5 Weight.- The weight of the transformer shall be held to a minimum, and shall not be greater than 30 pounds (13.6 kg).

3.4 Environmental conditions.- The transformer leads and connectors shall be capable of continuous, unimpaired operation when exposed to the environment as specified herein. Materials used in the construction of the transformers shall not exhibit any signs of degradation when exposed to the extremes of sunshine, petroleum solvents, or hostile soils as specified herein.

3.4.1 Temperature.- The transformer shall be constructed for continuous outdoor service at any ambient temperature from a minimum of -67°F (-55°C) to a maximum of +158°F (+70°C). It shall operate properly when buried in the ground with up to 264 volts on the primary windings and rated load on the secondary.

3.4.2 Solar radiation.- The material used to encapsulate the transformer and the insulation on the leads and connectors shall not be degraded by exposure to 110 watts per square foot of radiant energy, having a spectral distribution as defined in MIL-STD-810, Table 505.2-II, for a period of 48 hours.

3.4.3 Petroleum solvents.- The transformer case or the input/output lead insulation (including connectors) shall not be degraded or soluble in petroleum based solvents, including oil, gasoline, diesel or kerosene.

3.4.4 Hostile soil.- The transformer case or the input/output lead insulation (including connectors) shall not be degraded when buried in acid or alkaline soils having pH factors ranging from 4 to 9.

3.5 Materials.- Materials shall be as specified herein. When materials are not specifically designated, they shall be in accordance with FAA-G-2100. Materials not covered by FAA-G-2100 shall meet industrial standards.

3.5.1 Electrical conductors.- All electrical conductors shall be made of copper.

3.6 Nameplate.- The nameplate shall be as specified in FAA-G-2100 or molded on the case surface of the transformer. In addition, the following shall appear on the name plate:

Class:	Type I	Type II
Transformer Rating:	200 Watts	300 Watts
Frequency:	60 Hertz	60 Hertz
Primary Voltage:	240 Volts	240 Volts
Secondary Voltage:	30.3 Volts	45.5 Volts
Secondary Current:	6.6 Amperes	6.6 Amperes
Voltage Rating:	600 Volts	600 Volts
Specification:	FAA-E-2803	FAA-E-2803

3.7 Workmanship.- The transformer, including all parts and accessories, shall be constructed and finished in a thoroughly workman-like manner. Particular attention shall be given to neatness and thoroughness of soldering, wiring, impregnation of coils, freedom of case and leads from burrs and sharp edges, open pores in the case molding material, firmness of case molding material, and firmness of case molding to transformer lead sheath.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- The contractor shall provide and maintain a quality control program which fulfills the requirements of FAA-STD-013. Unless otherwise specified in this specification or in the contract, all tests and inspections to determine compliance with the requirements of the contract specifications shall be made by the contractor and shall be subject to Government inspection. The term "Government inspection" as used in this specification, means that an FAA representative will witness the contractor's testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements. The Government reserves the right to waive Government inspection at the contractor's plant. If Government inspection is waived, the contractor shall furnish to the Contracting Officer two copies of test data, certified by an independent testing agency, describing the results obtained during the inspection and tests required by the contract specification. The test data must demonstrate that the equipment meets contract requirements, and shall include the statement "This certifies that this unit fully meets all technical requirements of the contract", and be dated and signed by a responsible official of the contractor or testing agency. Certified test data shall be furnished to the Contracting Officer. Shipment shall not be made until the contractor receives written Government approval of the test data.

4.2 Production model tests.- The following test shall be conducted on two production models (preproduction units) of each type of transformer purchased to prove compliance with this specification. Unless otherwise specified, all tests shall be made at room temperature, approximately 77±9°F (25±5°C), using a controlled-voltage sinusoidal electrical source (variac or equal). In case it is necessary for water bath temperature to be substantially different from limits set herein, the proper temperature coefficient for the compound being used may be applied when computing insulation resistance values. It will be the manufacturer's responsibility to furnish proof that the coefficient used is correct. Proof shall be in the form of a certified test report furnished by the manufacturer. Joints between transformer leads, and between transformer leads and test leads, will not be taped during any of the insulation resistance or dielectric tests required in 4.2.3. and 4.3.2 herein.

4.2.1 Characteristics test.- The unit shall be tested to show that its electrical characteristics are as specified in table I. All corrections necessary to compensate for meter-power consumption shall be applied. The transformer shall be operated in air at room temperature with rated load connected to the secondary until the transformer windings have reached normal operating temperature, at which time measurements will be taken. Open circuit voltage measurements shall be made using a sinusoidal, 240-volt source having no more than 5 percent distortion and with the transformer under test constituting no more than 10 percent of the load capability.

4.2.2 Shock test.- The transformer shall be dropped twice from a height of 6 feet (1.82 meters) on a concrete floor; once so it hits on a bottom corner or location where the most damage is likely to occur due to the core cutting the case, and once so that it hits on a side or location where the most damage is likely to occur to the windings. Lead rigidity shall be tested by securing (just below the connector) each lead, one at a time, in a clamp and applying a 50-pound (22.67 kg) pull for 5 minutes. The lead clamp used shall be such that it would preclude damage to the lead at the point of attachment. After the completion of these tests, the transformer shall be tested to insure that it meets the secondary current and voltage requirements at rated load. A change of more than 1 percent from the results obtained in the test specified in 4.2.1 or evidence of damage to the case or attaching leads shall be cause for rejection.

4.2.3 Insulation resistance test.- The transformers shall be subjected to a continuous 20-cycle test as indicated below.

4.2.3.1 Mating connector test.- Mating connectors in accordance with AC 150/5345-26 shall be installed in the three connectors of the transformers. The mating connectors shall not be removed before completion of the 20-cycle testing. If they are removed for any reason, tests shall be repeated so that the transformers and their connectors satisfactorily pass 20 continuous cycles. Each cycle shall consist of the sequence of operations specified in 4.2.3.2, 4.2.3.3, and 4.2.3.4.

4.2.3.2 Transformer heating cycle test.- The transformers shall be operated, with mating connectors installed, for a minimum of 6 hours in air at room temperature with rated current flowing in primary coils. The secondaries of the transformers shall be fully loaded. This shall hereinafter be referred to as "the heating cycle".

4.2.3.3 Water immersion and hostile soil test.- Immediately following the heating cycle, the transformers, with leads and connectors, shall be completely submerged in water, at room temperature. The water in the test tank shall be grounded. Care should be taken to insure that all molded connections, on transformer leads and test harness, are completely immersed in water during this test. Immediately after immersion, the insulation resistance of each coil and lead assembly shall be measured as described in 4.2.3.5. The time period between interruption of the heating cycle and start of the measurement shall not exceed 3 minutes. The pH of this water shall be controlled as specified in 4.2.5.2.

4.2.3.4 Soaking test.- The transformers and their connectors shall be soaked in water, at room temperature, for not less than 12 hours, and the insulation resistance measurements repeated. The water in the test tank shall be grounded. This test shall be accomplished without current flowing in the transformer.

4.2.3.5 Resistance measurements.- Measurements of dielectric and insulation resistance shall be made with direct current. The test voltage shall be applied for 1 minute between each coil and ground, with the other coil grounded and its connectors submerged in water. The insulation resistance at the test voltage indicated shall equal or exceed the minimum values specified in table III. After the instrument needle settles down following current inrush, it shall remain steady without fluctuations. Zero and maximum

Table III. Minimum Insulation Resistance

Coil	DC Test Voltage	Minimum Insulation Resistance			
		Ambient Temperature		Operating Temperature	
		R	ELC	R	ELC
Secondary	5,000	750	6.7	300	16.7
Primary	5,000	750	6.7	300	16.7

NOTE: ELC = Equivalent leakage current in microamps

R = Minimum insulation resistance in megohms

readings of the test instrument shall be periodically checked, to verify operation of the high voltage tester, by touching the high voltage probe to the water surface and suspending it in air.

4.2.4 Test for temperature rise.- The transformer temperature rise shall be tested using the resistance method as defined below. Temperature rise shall be measured with 240 volts of primary voltage for two transformers. It shall be measured with the rated load (200 or 300 watts) and it shall not exceed 131°F (55°C) in any transformer.

$$\text{Temperature rise (°C)} = (234.5^{*} + T_c)\left[\frac{(R_h - R_c)}{R_c}\right]$$

where T_c = temperature (°C) corresponding to cold resistance

R_c = cold resistance of the windings

R_h = hot resistance of the windings

*This figure is for copper.

4.2.5 Environmental tests.- The transformer shall be subjected to environmental testing as specified herein.

4.2.5.1 Temperature test.-

4.2.5.1.1 High temperature.- The transformer shall be subjected to the maximum temperature specified in 3.4.1 in accordance with MIL-STD-810, Method 501.2, Procedure II, with 240 volts ac on the primary and rated load on the secondary. After the temperature has stabilized, operate the transformer for 4 hours at rated load. The procedure mentioned above shall be repeated for a period of 30 minutes with 264 volts ac on the primary and rated load on the

secondary. The unit shall continue to operate without degradation of performance, and the case shall not exhibit signs of blistering, cracking, discoloration, or softening.

4.2.5.1.2 Low temperature.- The transformer shall be subjected to the minimum temperature specified in 3.4.1 in accordance with MIL-STD-810, Method 502.2, Procedure II, with 240 volts applied on the primary and rated load on the secondary. After the temperature has stabilized, operate the transformer for 4 hours at rated load. The procedure mentioned above shall be repeated for a period of 30 minutes with 264 volts ac on the primary and rated load on the secondary. The unit shall continue to operate without degradation of performance, and the case shall not exhibit signs of blistering, cracking, discoloration, or softening.

4.2.5.2 Hostile soil test.- During the conduct of the water immersion test (4.2.3.3) the pH of the test water shall be adjusted by the addition of appropriate chemicals (acid or alkali) from 4 to 9. Ten immersion cycles shall be conducted at pH 4 and 10 cycles at pH 9.

4.2.5.3 Petroleum solvent test.- The transformer shall be soaked for 48 hours in a petroleum solvent solution consisting of equal parts of SAE 30 motor oil or equal, gasoline, kerosene or diesel. The case and leads of the unit shall not exhibit any signs of degradation upon removal from this solution.

4.2.5.4 Sunshine test.- The transformer shall be exposed to radiant energy at a rate of 110 watts per square foot in accordance with MIL-STD-810, Method 505, Procedure I. Examination of the unit after exposure shall not disclose any signs of degradation of the case or connection leads.

4.2.5.5 Weathering test.- The transformer shall be exposed to ozone in accordance with ASTM D 1149, with 100 parts-per-million (ppm) ozone, 38 C (100.4°F), 20 percent sample extension, and 100 hours exposure. Cracking of the case, connectors, or the connection leads as a result of testing shall be evidence of noncompliance.

4.2.5.6 Operational test.- The transformer shall be buried in dry sand and operated for 4 hours. Examination of the unit after the test shall not disclose any signs of degradation of the case or connection leads.

4.3 Production unit tests.- All transformers offered for delivery shall be subjected to the tests specified in 4.3.1 through 4.3.3.

4.3.1 Ratio test.- Test each transformer for voltage ratio at rated frequency with 240 volts on the primary and a 200 or 300-watt load, as applicable, on the secondary. The secondary voltage of the 200-watt transformer shall be between 30.00 and 30.60 volts ac. The secondary voltage of the 300-watt transformer shall be between 45.04 and 45.96 volts ac.

4.3.2 Dielectric test.- Subject each transformer to one complete cycle of the test specified in 4.2.3. The transformers may be oven-heated to a temperature known to equal or exceed that obtained in the 6-hour, full-load circuit condition.

4.3.3 Test for voids.- The maximum pressure which can be exerted directly with the hands shall be applied to all parts of the transformer case. Any evidence of voids beneath the surface of the case shall be cause for rejection.

4.4 Test instrumentation.- The manufacturer or the testing laboratory performing pre-production and production tests shall provide adequate instrumentation for these tests. All instruments shall have calibration labels indicating that the instruments have been calibrated by a reliable laboratory. Indicating instruments, voltmeters, and ammeters shall be of the one-half of 1 percent classification or better. Alternating current instruments shall be true RMS types.

4.5 Test performance.- All tests described above shall be performed at the contractor's expense at the contractor's facility or at an FAA approved independent testing laboratory. All tests shall be witnessed by an FAA representative. A minimum of 10 days notice of inspection readiness should be given. Tests shall be conducted on the production model and on production units as outlined above to prove compliance with this specification.

5. PREPARATION FOR DELIVERY

5.1 General.- Unless otherwise specified in the contract, each Transformer shall be prepared for domestic shipment as specified herein.

5.1.1 Packaging.- Packaging shall be in accordance with Specification MIL-P-116, Method III. Separate packaging shall be provided for each transformer.

5.1.2 Packing.- Packing shall be in accordance with Specification MIL-E-17555, Level B.

5.1.3 Marking.- Packages shall be durable and legibly marked with the following information:

Quantity ----------

Item ---------- Transformer

Type ----------

Wattage ----------

Primary Voltage ----------

Secondary Voltage ----------

Specification Number ---------

National Stock Number --------

Manufacturing Name
or Trademark ----------

6. NOTES.- The contents of the subparagraphs below are only for the information of the Contracting Officer. They are not contract requirements, and are not binding on either the Government or the contractor except to the

extent that they may be specified elsewhere in the contract as such. Any reliance placed by the contractor on the information is wholly at the contractor's own risk.

6.1 Deliverable items.- The following items are to be called out in the contract documents as deliverable items under this specification:

(a) Potential isolation transformer, 200-watt, 240 volt ac primary, 30 volt ac secondary, 60 hertz

(b) Potential isolation transformer, 300-watt, 240 volt ac primary, 45 volt ac secondary, 60 hertz

6.2 Scheduled events.- The following scheduled events are to be included in the contract:

(a) Preliminary design review

(b) Critical design review

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